

hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out in a polar reaction medium and metal complexes that are soluble in the reaction medium are used as the hydrogenation catalysts with ligands comprising tertiary phosphines, or comprising bidentate ligands with a tertiary amine group and a phosphine group or with two tertiary phosphine groups as complexing groups, whereby the bidentate ligands form together with a metal atom a five- to ten membered ring.

2. (Amended) The process according to claim 1, wherein the polar reaction medium is an aqueous or alcoholic reaction medium.

3. (Amended) The process according to claim 1, wherein the pterin derivatives used are folic acid, folic acid salts, folic acid esters, folic acid ester salts or dihydro forms thereof for hydrogenation with hydrogen in the presence of a hydrogenation catalyst, the hydrogenation carried out at elevated pressure in the presence of metal complexes dissolved in the reaction medium as hydrogenation catalysts, with the proviso that in the event of using folic acid, carboxylic acids thereof or dihydro forms thereof the reaction medium is aqueous, and in the event of using folic acid esters, folic acid ester salts or dihydro forms thereof the reaction medium is an alcohol.

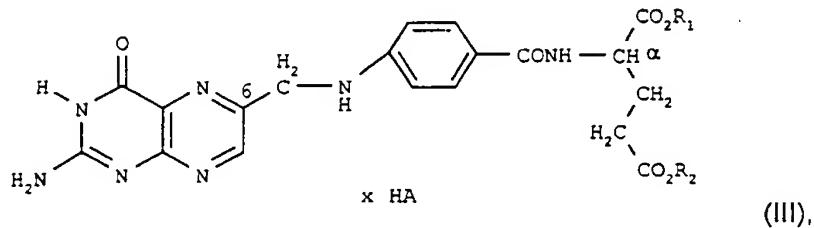
4. (Amended) The process according to claim 1 for the asymmetric hydrogenation of prochiral pterin derivatives with hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out in a polar reaction

medium and metal complexes that are soluble in the reaction medium are used as the hydrogenation catalysts, the metal complexes containing chiral ligands.

a'

5. (Amended) The process according to claim 4 for the asymmetric hydrogenation of folic acid, folic acid salts, folic acid esters, folic acid ester salts or dihydro forms thereof as pterin derivatives, with hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out at elevated pressure in the presence of metal complexes dissolved in the reaction medium as hydrogenation catalysts, the metal complexes containing chiral ligands, with the proviso that where folic acid, carboxylic acid salts thereof or dihydro forms are used, that the reaction medium is aqueous, and where folic acid esters, folic acid ester salts or dihydro forms thereof are used, the reaction medium is an alcohol.

6. (Amended) The process according to claim 5, wherein the folic acid ester salts satisfy formula III and are in the form of their enantiomers or mixtures,



Q /

in which R₁ or R₂ is H, and one of R₁ or R₂ or both R₁ and R₂ independently of one another represent a monovalent hydrocarbon radical or a radical attached via a carbon atom, with heteroatoms selected from the group comprising -O-, -S-, and -N-, HA stands for a monobasic to tribasic inorganic or organic acid, and x denotes an integer from 1 to 6 or a fractional number between 0 and 6.

7. (Amended) The process according to claim 6, wherein the acid HA in formula III is unsubstituted or substituted phenylsulphonic acid.

8. (Amended) The process according to claim 1, wherein said process is carried out at a hydrogen pressure of 1 to 500 bars.

9. (Amended) The process according to claim 1, wherein the temperature is 0 to 150⁰ C.

10. (Amended) The process according to claim 1, wherein the molar ratio of substrate to catalyst is 10 to 100,000.

11. (Amended) The process according to claim 1, wherein the aqueous reaction medium is water or water in admixture with an organic solvent.

12. (Amended) The process according to claim 2, wherein the alcoholic reaction medium is an alcohol, or an alcohol in admixture with an organic solvent.

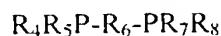
13. (Amended) The process according to claim 1, wherein the metal complexes contain a d-8 metal comprising iridium, rhodium or ruthenium.

a'

14. (Amended) The process according to claim 1, wherein the metal complex contains achiral or chiral ditertiary diphosphines as ligand.

15. (Amended) The process according to claim 14, wherein the ditertiary diphosphines for an alcoholic reaction medium are ones in which the phosphine groups are attached (a) to various carbon atoms of a hydrocarbon chain having 2 to 4 carbon atoms, or (b) directly via a bridging group $-CR_aR_b-$ in the ortho positions of a cyclopentadienyl ring or to a cyclopentadienyl ring of a ferrocenyl, where Ra and Rb are the same or different and stand for H, C₁-C₈ alkyl, C₁-C₄ fluoroalkyl, C₅-C₆ cycloalkyl, phenyl, benzyl, or phenyl or benzyl substituted with 1 to 3 C₁-C₄ alkyl or C₁-C₄ alkoxy.

16. (Amended) The process according to claim 14, wherein the diphosphines which can be used in an alcoholic reaction medium satisfy formula IV,



(IV)

in which

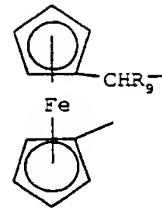
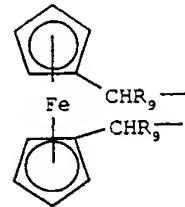
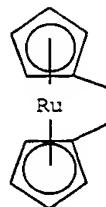
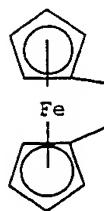
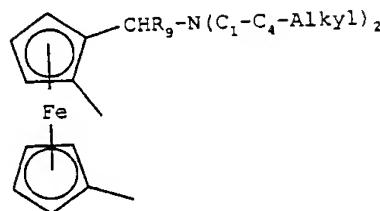
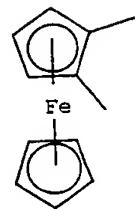
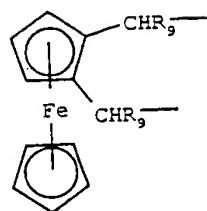
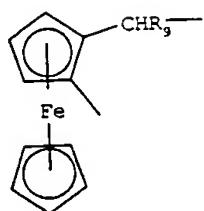
R₄, R₅, R₇ and R₈ independently of one another represent a hydrocarbon radical with 1 to 20 carbon atoms, which is unsubstituted or substituted with halogen, C₁-C₆ alkyl, C₁-C₆

a)

haloalkyl, C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, (C₆H₅)₃Si, (C₁-C₁₂ alkyl)₃Si, -NH₂, -NH(C₁-C₁₂ alkyl), -NH(phenyl), -NH(benzyl), -N(C₁-C₁₂ alkyl)₂, -N(phenyl)₂, -N(benzyl)₂, morpholinyl, piperidinyl, pyrrolidinyl, piperazinyl, -ammonium-X₃⁻, -SO₃M₁, -CO₂M₁, -PO₃M₁, or -CO₂C₁-C₆ alkyl, in which M₁ represents an alkali metal or hydrogen and X₃⁻ is the anion of a monobasic acid; or R₄ and R₅, and R₇ and R₈ respectively together denote tetramethylene, pentamethylene, or 3-oxa-pentane-1,5-diyl, unsubstituted or substituted with halogen, C₁-C₆ alkyl or C₁-C₆ alkoxy; and R₆ is C₂-C₄ alkylene, unsubstituted or substituted with C₁-C₆ alkyl, C₁-C₆ alkoxy, C₅ or C₆ cycloalkyl, phenyl, naphthyl, or benzyl; 1,2 or 1,3-cycloalkylene, 1,2- or 1,3-cycloalkylenylene, 1,2- or 1,3-bicycloalkylene or 1,2- or 1,3-bicycloalkenylene with 4 to 10 carbon atoms, unsubstituted or substituted with C₁-C₆ alkyl, phenyl, or benzyl; 1,2- or 1,3-cycloalkylene, 1,2- or 1,3-cycloalkylene, 1,2- or 1,3-bicycloalkylene or 1,2- or 1,3-bicycloalkylene with 4 to 10 carbon atoms, unsubstituted or substituted with C₁-C₆ alkyl, phenyl, or benzyl, at whose 1 and/or 2 positions or at whose 3-position methylene or C₂-C₄ alkylidene is attached; 1,4-butylene substituted in the 2,3 positions with R₉R₁₀C(O-)₂, and which in the 1 and/or 4 positions is unsubstituted or substituted with C₁-C₆ alkyl, phenyl, or benzyl, and where R₉ and R₁₀ independently of one another represent hydrogen, C₁-C₆ alkyl, phenyl or benzyl; 3,4- or 2,4-pyrrolidinylene or methylene-4-pyrrolidine-4-yl whose nitrogen atom is substituted with hydrogen, C₁-C₁₂ alkyl, phenyl, benzyl, C₁-C₁₂ alkoxy carbonyl, C₁-C₈ acyl, C₁-C₁₂ alkylaminocarbonyl; or denotes 1,2-phenylene, 2-benzylene, 1,2-xylylene, 1,8-naphthylene, 2,2'-dinaphthylene or 2,2'-diphenylene, unsubstituted or substituted with halogen, -OH, C₁-C₆ alkyl, C₁-C₆

alkoxy, phenyl, benzyl, phenoxy or benzyloxy; or R₆ stands for a radical of the formulas

a'



in which R₉ denotes hydrogen, C₁-C₈ alkyl, C₁-C₄ fluoroalkyl, unsubstituted phenyl or phenyl substituted with 1 to 3F, Cl, Br, C₁-C₄ alkyl, C₁-C₄ alkoxy or fluoromethyl.

a'

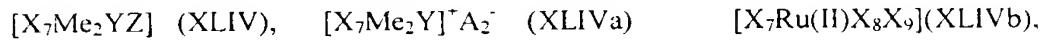
17. (Amended) The process according to claim 14, wherein diphosphines for an aqueous reaction medium are ones that contain one or more water-solubilising polar substituents, which are attached either direct or via a bridging group to substituents of the phosphine groups.

18. (Amended) The process according to claim 17, wherein the diphosphines for an aqueous reaction medium are ones of formula XLIII,



in which M_1 , stands for H, an alkali metal cation or an ammonium cation, R_{42} denotes C_1-C_4 alkyl and preferably H, and R_{41} is the monovalent radical of a chiral diteritary diphosphine, with the CO group being attached direct to a carbon or nitrogen atom of the diphosphine skeleton, or to an oxygen or nitrogen atom or to a carbon atom of a bridging group of the diphosphine skeleton.

19. (Amended) The process according to claim 1, wherein the hydrogenation catalysts are metal complexes of formulas XLIV, XLIVa and XLIVb.



in which

Y stands for monoolefin ligands or a diene ligand;

a / X₇ represents an achiral or chiral ditertiary diphosphine that forms a 5 to 7 membered ring with the metal atom Me₂ or Ru;

Me₂ denotes Ir(I) or Rh(I);

Z represents -Cl, -Br, or -I; and

A₂ is the anion of an oxy-acid or complex acid;

X₈ and X₉ are the same or different and have the meaning of Z and A₂, or X₈, and

X₉ stands for allyl or 2-methylallyl, or X₈ has the meaning of Z or A and X₉ stands for hydride.

Please add the following new claims:

A²

-- 29. A process for the preparation of tetrahydropterin and tetrahydropterin derivatives by the hydrogenation of pterin and pterin derivatives with hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out in a polar reaction medium and metal complexes that are soluble in the reaction medium are used as the hydrogenation catalysts and wherein the alcoholic reaction medium is an alcohol, or an alcohol in admixture with an organic solvent.

30. A process for the preparation of tetrahydropterin and tetrahydropterin derivatives by the hydrogenation of pterin and pterin derivatives with hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out in a polar reaction medium and metal complexes that are soluble in the reaction medium are used as the hydrogenation catalysts and wherein the metal complex contains achiral or chiral ditertiary diphosphines as ligand.

31. A process for the preparation of tetrahydropterin and tetrahydropterin derivatives by the hydrogenation of pterin and pterin derivatives with hydrogen in the presence of a hydrogenation catalyst, wherein the hydrogenation is carried out in a polar reaction medium and metal complexes that are soluble in the reaction medium are used as the hydrogenation catalysts wherein the metal complex contains achiral or chiral ditertiary diphosphines as ligand and wherein the ditertiary diphosphines for an alcoholic reaction medium are ones in which the phosphine groups are attached (a) to various

A² carbon atoms of a hydrocarbon chain having 2 to 4 carbon atoms, or (b) directly via a bridging group $-CR_aR_b-$ in the ortho positions of a cyclopentadienyl ring or to a different and stand for H, C₁-C₈ alkyl, C₁-C₄ fluoroalkyl, C₅-C₆ cycloalkyl, phenyl, benzyl, or phenyl or benzyl substituted with 1 to 3 C₁-C₄ alkyl or C₁-C₄ alkoxy.

32. The process according to claim 14, wherein the ditertiary diphosphines are tertiary phosphino imines. --
